Textile Care Technology Spectra and Care Labeling Issues

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Introduction

Apparel and textiles fulfill essential functional and aesthetic needs. Social-psychological, physiological, physical, cultural, and economic parameters traditionally influence apparel selection, purchasing, and wearing decisions. As we become more aware of the impact of our activities on the environment, questions about the interface between apparel and the environment are raised and enter into the decision-making process.

Apparel and textiles are soiled during normal use. Economic realities require that apparel and textiles be cleaned and refurbished for reuse without substantially altering their functional and aesthetic properties. Consumers have the choice to clean and refurbish apparel at home or have it done in professional cleaning establishments. It is essential that available cleaning processes maintain or restore the desirable and functional attributes of the textiles. This is the joint responsibility and opportunity of the textile and apparel industry, the textile care industry, and the consumer.

The Federal Trade Commission (FTC) promulgated a trade regulation rule on the care labeling of textile wearing and certain piece goods in 1971 and amended it in 1983. The rule requires that apparel items have a permanent care label that provides written information about their regular care. The purpose of the rule is to give the consumer accurate care information to extend the useful life of a garment.

The formation of the North American Free Trade Agreement between the United States, Canada, and Mexico provided the stimulus for using care symbols instead of words. The American Society for Testing and Materials has developed laundering and dry cleaning symbols which the FTC is about to implement. FTC's current rule requires that manufacturers and importers of textile wearing apparel have a reasonable basis and reliable evidence in support of care instructions. Both subjective and objective selection criteria are allowed.

This presentation outlines the complexity of textile care and addresses the difficulties encountered in defining reliable care instructions. Conceptual textile care spectra for nonaqueous and aqueous cleaning processes will be presented and technology options, cleaning mechanisms, textile property issues, and garment damage potentials will be discussed.

Discussion of Textile Care Process Spectra

Textile Care Process Spectrum: Technology Options

At the Hamilton Environmental Summit in 1993, textile cleaning was redefined as a generic process. This redefinition dispels the paradigm that dry cleaning means cleaning in percholoroethylene (perc) only. To initiate textile cleaning, we must break the soil-textile interaction forces to loosen and transport the heterogeneous soils away from the textiles. It does not matter if the medium is a liquid, a gas, or even a solid. We must be able to purify and reuse the chosen medium. The soils should be concentrated for proper disposal, preferably as nonhazardous waste. But what is more important, the process must clean clothes to satisfy consumer needs, and it must be economically feasible and environmentally acceptable. Today, let us consider two practical boundary technologies: nonaqueous and aqueous cleaning.

Nonaqueous Textile Cleaning

There will always be a need for a nonaqueous textile cleaning technology. It is dictated by the properties of textiles and soils, but the medium does not have to be perchloroethylene only. We know that perchloroethylene is a proven medium for professional textile cleaning. Any other nonpolar media, such as petroleum, carbon dioxide, or other nonpolar liquids, which meet the textile cleaning performance requirements, could be chosen.

Aqueous Textile Cleaning

At the other end of the spectrum is aqueous cleaning. We showed that the advanced professional wet cleaning technology makes it feasible to clean many textiles that are traditionally cleaned in nonaqueous media. The challenge for our industry is to prove that this professional aqueous cleaning technology offers sufficient advantages to consumers so that they do not do more wetcleaning at home.

Textile Care Process Spectrum: Cleaning Mechanism

Colloid chemistry in nonaqueous and aqueous media allows satisfactory textile cleaning. The mechanisms which govern polar, nonpolar, and particulate soil removal are reasonably understood for both media. We know that polar soils are more easily removed in water than in nonpolar solvents and that nonpolar soils are more easily removed in nonaqueous solvents. Professional textile cleaners can optimize soil removal if they have access to both media.

Textile Care Process Spectrum: Textile Properties

The structure and properties of fibers, yarns, fabrics, and colorants ultimately determine which cleaning process is best for them. Professional cleaners cannot change textile properties, but they must know as much as possible about them in order to choose the best textile cleaning process. The spectrum of textile properties dictates which cleaning process technology (nonaqueous or aqueous) is best to maintain desirable textile attributes.

Textile Care Process Spectrum: Preferred Methods for Garments

Based on field studies, we established preferred methods for cleaning specific garments. Tailored or structured garments and high fashion items often have linings, interfacing, trims, and other accessories or have complex design features. They often behave differently in the same cleaning medium. Damage to these items is less likely to occur in nonaqueous media than in aqueous cleaning media. Thus, these garments are best cleaned in a nonaqueous media. Many garments, such as overcoats, trousers, raincoats, parkas, or sweaters may be cleaned in either media. Shirts, blankets, sleeping bags, and linens are best wetcleaned. Occasionally, excessive polar or nonpolar soiling dictates and overrides textile cleaning media selection criteria.

Textile Care Process Spectrum: Garment Damage Potential

A deviation from care label instructions increases the risk of garment failure. We do not recommend it, but each operator, of course, has the option to ignore care instructions. But if the cleaner damages a garments, they will be responsible for it. The potential damage to garments during cleaning is generally higher with aqueous media than with nonaqueous media. This fact is the major reason why dry cleaning is so highly utilized. Often, manufacturers low-label their garments as “Dry Clean Only” to reduce garment damage and to ensure customer satisfaction during the use of their products. I would now like to discuss the more important types of garment damage that can occur.

Practical Shrinkage Potential

When garments shrink more than 2 or 3 percent, the garments do not fit well anymore and consumers will notice it. Shrinkage can occur during the cleaning, drying, or finishing process. The new wet cleaning technology optimizes and controls the well-known process parameters to reduce shrinkage: time, mechanical action, heat, and chemistry. Practicing textile care specialists classify shrinkage into two categories: felting and relaxation.

Felting Shrinkage: This type of shrinkage is unique to wool because wool fibers have surface scales that cause differential friction effects. When wool fibers swell, as they do in water, the scales expand and are lifted. This increases differential friction between fibers and interlocks and compacts them which causes felting shrinkage. It is possible to reduce but not eliminate the felting potential of wool with process additives that lower interfiber friction and reduce fiber swelling.

Relaxation Shrinkage: During fabric and garment manufacturing, textiles are often stretched, shaped, and dried under tension. This causes latent stresses at the macroscopic level (between fibers and yarns) and at the microscopic level (within the fiber morphology). The macroscopic stresses are generally relaxed by mechanical action that allows movement between fibers and yarns. Microscopic stress is released by plasticization. Plasticization occurs when fibers swell in a liquid medium or when excessive energy (heat) is applied during drying. Either action lowers the cohesive energy between amorphous polymer segments and causes relaxation within the fiber matrix, leading to shrinkage.

Theoretical Aspects of Shrinkage

Like all processes in nature, shrinkage is governed by the potential that it can occur (thermodynamic) and by the rate at which it can occur (kinetics). These aspects are fundamental issues in polymer science and have been studied and documented extensively for natural and synthetic fibrous polymers.

Thermodynamics theory predicts that there is a balance between cohesive energy and entropy when a process is at equilibrium. The cohesive energy between molecules retains the shape and dimension of a fibrous polymer solid, while the entropy opens it and allows the segmental relaxation that leads to shrinkage. This balance establishes the fibrous shape and stability that is disturbed and temporally fixed into a non-equilibrium position during textile and garment manufacturing.

When fibers swell in a liquid or are heated above their glass transition temperature during cleaning or drying in air, cohesive energy force weakens and entropy forces dominate. This relaxes the morphology and the fibers shrink. But because polymeric fibers are visco-elastic, the thermodynamically feasible end points are not reached instantaneously. Under these conditions, the kinetics of the process will determine the dimensional properties of fibers. Therefore, we can only delay relaxation shrinkage during textile cleaning, we cannot stop it.

The practical consequence is that relaxation shrinkage takes time and occurs cumulatively over several cleaning cycles. All textile cleaning professionals are very familiar with the phenomenon and know it as progressive shrinkage. If we can find a cleaning and finishing process that delays perceivable relaxation shrinkage long enough to exceed a garment's life cycle, consumers will be satisfied. Nonaqueous cleaning does this readily, but it is much more difficult to manage with aqueous cleaning.

The research efforts and assessment of the feasibility of professional wetcleaning within the Research Committee RA-43 of the American Association of Textile Chemists and Colorists will focus on practical and fundamental principles of shrinkage. This will allow us to establish fundamental guidelines for shrinkage prediction and control.

Potential Appearance and Tactile Changes

Consumers purchase new textiles based on visual and tactile perception. Cleaning experts strive to retain or restore the physical properties that cause the desirable sensory attributes of textiles triggering positive purchasing decisions. This means to retain the original colors, textures, and finishes during cleaning, or to restore them if undesirable changes have occurred. Again, it is easier to retain these properties during nonaqueous cleaning than during aqueous cleaning.

Claims that dye bleeding and staining can be prevented need to be verified. While it is possible to control selective colorant removal and staining, the diverse nature and properties of colorants and textiles suggest that it will be difficult to live up to such a broad claim. The real issue here is proper dyeing and colorfastness evaluation during textile manufacturing. Textile and apparel manufacturers, retailers, and textile care specialists must work together to establish quality and test protocols that predict satisfactory cleaning performance of textiles.

Most dry cleaners use fabric finishes to restore or improve the hand and feel of drycleaned fabrics. Fabric finishes for aqueous cleaning are also available to achieve the same desirable effects.

Summary

1. Textile care professional need access to nonaqueous and aqueous cleaning technologies.
2. Care label instructions can be derived from objective national and international test methods.
3. Conceptual textile care spectra for nonaqueous and aqueous processes can assist in selecting proper textile cleaning processes.
4. Garment shrinkage potential can be explained by considering practical and theoretical principles.
5. National and international organizations coordinate their efforts to establish objective test methods for care label instructions.
6. It is necessary to work closely with all members of the apparel industry to optimize garment performance as new textile care processes emerge.

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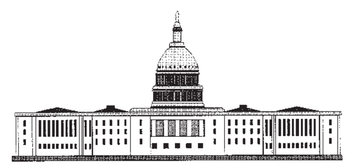
Textile Care Spectra & Care Labeling

Dr. Manfred Wentz

Apparel Care and The Environment
Washington, DC
September 9-10, 1996



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Criteria for Selection and Use of Clothing:

- Social - Psychological
- Aesthetic
- Cultural
- Physical
- Economics

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Traditional Criteria Expanded:

- Care Requirements:
  - home laundering
  - drycleaning
  - professional wetcleaning
- Environmental Concerns

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All Members of Apparel Chain Affected:

- Fiber, Yarn & Fabric Producers
- Apparel Manufacturers
- Retail Industry
- Textile Care Industry

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Care Labeling Rule Requirements:

- Care labels must give full instructions for at least one satisfactory method of care
- Must give warning about any part of the recommended care method that would harm the garment

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Care Labeling Rule Requirements *(continued)*:

- State when there is no method for cleaning without damage
- Must have a reasonable basis for care instructions

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Reasonable Basis Requirement for Care Labeling:

- Reliable Evidence That:
  - product not harmed after repeated cleanings as recommended
  - product was harmed when cleaned by method warned against

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Reasonable Basis Requirement for Care Labeling *(continued)*:

- Reliable Evidence That:
  - product was successfully tested
  - technical literature, experience or expertise supports care instructions
  - other evidence

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Care Label Instructions Can Be:

- Subjective
- Objective

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Care Label Instructions Based on Subjective Judgments:

- Risky, more likely to be wrong
- Relatively inexpensive
- Method of choice for short runs
- Low labeling more likely

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Based on Objective Testing:

- More reliable if done right
- Relatively expensive
- Method of choice for long runs
- Low labeling less likely

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Objective Test Methods Available:

- American Association of Textile Chemists & Colorists *(AATCC)*
- American Society for Testing & Materials *(ASTM)*
- International Organization for Standardization *(IOS)*

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Textile Care Process Options:

- Non-Aqueous Cleaning
  - non-polar solvents
- Aqueous Cleaning
  - polar solvent

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Requirements for Any Textile Cleaning Process:

- Must Clean Clothes Satisfactorily
- Must Extend Useful Life of Garments
- Must be Economically Feasible
- Must be Environmentally Acceptable

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Textile Care Process Spectra:

- Technology Options
- Cleaning Mechanism
- Textile Property Issues
- Preferred Methods for Garments
- Garment Damage Potential

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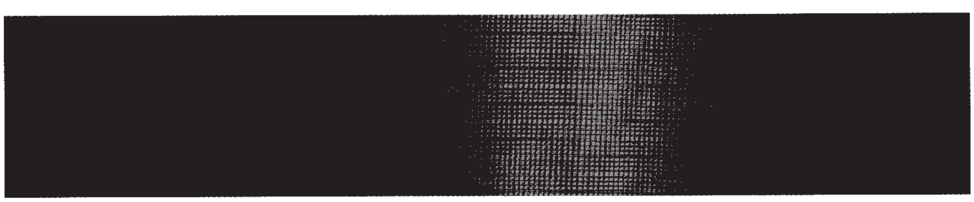
Textile Care Process Spectrum
Technology Options



Non-aqueous Cleaning
- Perc
- Petroleum
- Carbon Dioxide (?)
- Others (?)

Aqueous Cleaning
- Manual
- Machine
  - Household
  - Commercial

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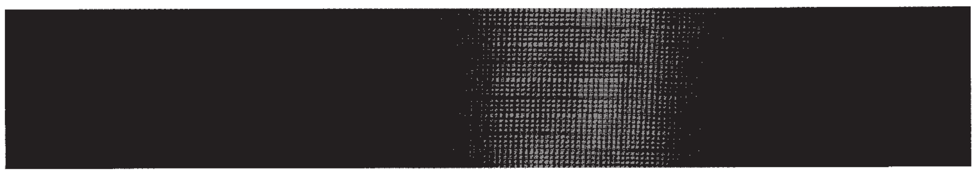
Textile Care Process Spectrum
Cleaning Mechanism



Non-aqueous Cleaning — *Aqueous Cleaning*

Solubilization	**Water Soluble (polar) Soil**	Solution
Solution	**Oil Soluble (non-polar) Soil**	Solubilization
Suspension	**Particulate (solid) Soil**	Suspension

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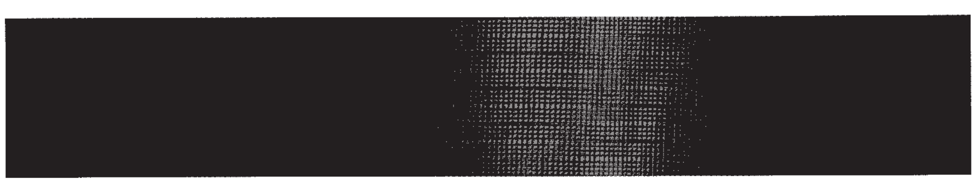
Textile Care Process Spectrum
Textile Property Issues



Non-aqueous Cleaning — *Aqueous Cleaning*

Hydrophilic	**Fibers**	Hydrophobic
Low twist	**Yarns**	High twist
Low count	**Fabrics**	High count
Polar	**Colorants**	Non-polar

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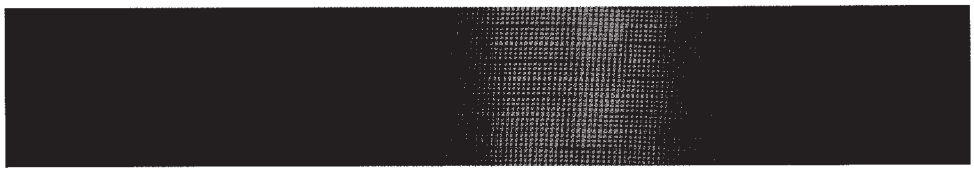
Textile Care Process Spectrum
Preferred Methods for Garments



Non-aqueous Cleaning ⟷ *Aqueous Cleaning*

Men's Suits	**Overcoats**	Parkas	**Shirts**
Women's Suits	**Trousers**	Windbreakers	**Blankets**
Tailored Jackets	**Dresses**	Raincoats	**Sleeping Bags**
Fashion Items	**Skirts**	Sweaters	**Linens**

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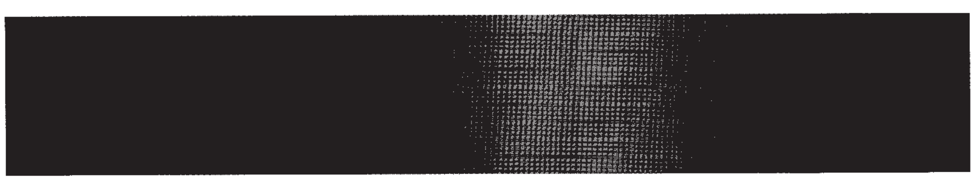
Textile Care Process Spectrum
Garment Damage Potential



Non-aqueous Cleaning *Aqueous Cleaning*

Shrinkage Potential
Low ⟷ High

Potential Appearance Change
Low ⟷ High

Potential Tactile Change
Low ⟷ High

Care Label
Dryclean Only ⟷ Do not dryclean

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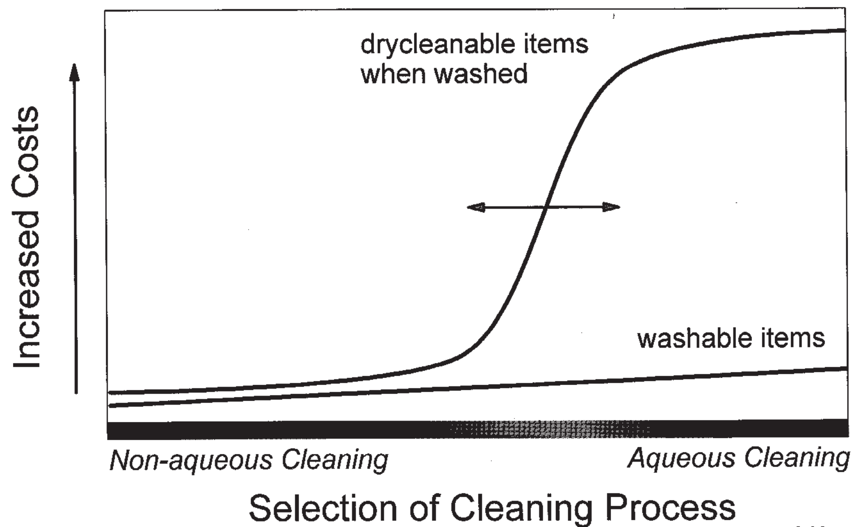
Textile Care Process Spectrum
Finishing Costs



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Mechanisms of Shrinkage

- Felting
- Relaxation
- Thermal

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Felting Shrinkage

- Mechanism
  - scales of wool cause differential friction
  - leads to interlocking and felting of fibers
- Minimization
  - lower inter-fiber friction with additives
  - reduce mechanical action

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Relaxation Shrinkage

- Mechanism
  - water plasticizes fiber structure
  - releases latent tension in fibers and yarns
- Minimization
  - can only be delayed, not stopped
  - reduce mechanical actions

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Thermal Shrinkage

- Mechanism
  - heat plasticizes hydrophobic fiber structure
  - releases latent tension in fibers and yarns
- Minimization
  - keep all process temperatures below glass transition temperature

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Color Fastness of Textiles:

- Mode of Application (dyeing, printing)
- Solubility Properties of Colorant
- Dye Transfer Potential

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Conclusions:

- Textile care professional need access to non-aqueous and aqueous cleaning technologies
- Care label instructions can be derived from objective national and international test methods

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Conclusions *(continued)*:

- Conceptual textile care spectra for non-aqueous and aqueous processes can assist in selecting proper textile cleaning processes
- Garment shrinkage potential can be explained by considering practical and theoretical principals

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Conclusions *(continued)*:

- It is necessary to work closely with all members of the apparel chain to optimize garment performance as new textile care processes emerge
- National & international organizations coordinate their efforts to establish objective test methods for care label instructions